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Compatibility of the winter moth parasitoid *Cyzenis albicans* (Tachinidae) with pesticide use in the cultivation of blueberries in the Fraser Valley

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ABSTRACT

The potential for the use of the tachinid fly, *Cyzenis albicans* Fall., as an alternative control of winter moth, *Operophtera brumata* L. on blueberries was evaluated with respect to the flies' compatibility with late season clean-up insecticide sprays. Pupae of *Cyzenis* suffered no greater mortality when exposed to malathion sprays than did those not exposed to such sprays. Mechanisms of protection for the tachinid from insecticides and its potential for biological control in blueberries are discussed.

INTRODUCTION

One of the major problems associated with the introduction or conservation of natural enemies for the control of pests in agricultural crops, is the incompatibility of the control agents with the use of pesticides. Well established crops typically have a standard regimen of insecticide application; the success of biological control agents must then be evaluated within the context of pesticide use. This problem is exacerbated by the tendency for natural enemies to be affected more severely by insecticides than are their hosts (Bartlett, 1964).

An increasing problem in blueberry (*Vaccinium corymbosum*) cultivation in the Fraser Delta has been the spread of the introduced winter moth, *Operophtera brumata* (Geometridae), from Vancouver Island (Embree and Otvos, 1984). Two features of the biology of this insect makes control difficult: 1. early hatch (late March to early April) results in first- and second-instar larvae feeding inside unopened buds making detection difficult until heavy damage has occurred, and 2. feeding by larvae is greatest during the period of blueberry bloom when pesticides cannot be applied because of bee activity.

Commercial production of blueberries in the Lower Fraser Valley, British Columbia, utilizes a number of insecticidal sprays in spring for the control of lepidopterous larvae, especially geometrids and tortricids, and in summer for pre-harvest control of a wide variety of insects (British Columbia Ministry of Agriculture and Fisheries, 1988). The difficulty of winter moth control using insecticides could be potentially reduced by the use of natural enemies. The tachinid fly, *Cyzenis albicans* (Tachinidae), has contributed to control of winter moth in oakwoods (Embree, 1971, Roland, 1988, 1990). *Cyzenis* may be a useful addition to the current practice of blueberry cultivation reducing the need for spring application of insecticides, provided that the flies are not affected by the late-season (pre-harvest) insecticide sprays. This paper addresses the compatibility of *Cyzenis albicans* with late-season insecticide applications.

Insect phenology

Winter moth larvae feed on the foliage of many deciduous trees and shrubs until late May. *Cyzenis albicans* emerge from the soil in April, and oviposit on foliage on which host larvae are feeding. Parasitoid eggs are ingested by the feeding host caterpillars. Fully-fed, final instar caterpillars drop to the ground to pupate in late May and early June. Both the parasitized and unparasitized caterpillars pupate in the soil at a depth of 2–3 cm (Roland, 1986a). Within three to four weeks, in late June, *Cyzenis* maggots have completed feeding, and pupate inside the host's pupal case and cocoon. *Cyzenis* remain in the soil as pharate adults within their puparia until the following spring. Unparasitized winter moth pupae remain in the soil only until November or December when they emerge as adults. Both *Cyzenis* and its host would be present in the soil at the time of the pre-harvest clean-up spray.

MATERIALS AND METHODS

Cyzenis albicans were obtained in May 1988, by collecting parasitized hosts in an unsprayed apple orchard in Victoria, B.C. (sites described in Roland, 1986b). Twenty cocoons were placed in each of sixteen 15-cm diameter Petri dishes filled with damp peat soil collected from a commercial blueberry field (Richland Farms, Richmond, B.C.). Eight of the 16 dishes were exposed to Malathion spray in the field on June 26, by placing dishes under blueberry bushes, the normal location for winter moth pupation. Malathion 50 EC (500 g malathion/litre) was applied at the rate of 550 g a.i./ ha; the recommended rate for pre-harvest insect control on blueberries (British Columbia Ministry of Agriculture and Fisheries, 1988). The eight control dishes were similarly set out in the field, but were not exposed to insecticide spray. Dishes were collected after 1 h, and kept in separate cages inside a screened shade house. The proportion of *Cyzenis* flies emerging the following spring was recorded for each replicate. The proportions surviving in the treatments and controls were compared with a one-way Analysis of Variance after transformation by arc-sine square-root.

RESULTS AND DISCUSSION

There was no effect from late-season malathion sprays on the survival of *Cyzenis* ($F=1.08$, $df=1$, $P=0.32$). Over-all, 96% of *Cyzenis* survived in the control replicates, 97% survived in replicates which had been sprayed with malathion. Preharvest sprays with malathion appeared to have no effect on the survival of *Cyzenis*. Insecticides containing organochlorine, organophosphate and carbamate are known to be inactivated in soils high in organic matter probably because of adsorption. The mechanism of inactivation, however, is not clear. Harris (1964), demonstrated that in moist soils inactivation of insecticides such as heptachlor, DDT, diazinon, V-C 13 and parathion was proportional to the organic content of the soil. The absence of any impact of malathion on *Cyzenis* mortality may be due to the strong adsorption to, and inactivation in, the moist organic peat in which blueberries are typically grown. Another contributing factor may be the rapid degradation of malathion in soil. Malathion is known to be non-persistent in soils (Mulla et al., 1981). Under field conditions, 85% of malathion residues were lost from a silt loam during the first three days following application (Lichtenstein and Schulz, 1964). Malathion persisted least in moist soils (Lechtenstein and Schulz, 1964). Rapid disappearance ensures that malathion would have no residual effect on *Cyzenis* mortality. If *Cyzenis albicans* were to be used as an adjunct to current control of winter moth larvae in early spring, it appears that they will not suffer from clean-up sprays applied late in the summer. Biological control agents which pupate in damp organic soils, typical of blueberry production, may have enhanced suitability because they are not susceptibile to insecticides.

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